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Name of Applicant(Firm): Asahi Dow Ltd.

Title: METHOD FOR MOLDING HOLLOW SHAPED ARTICLE

Claim:

1. A method for molding a hollow shaped article, which comprises injecting into a mold cavity a molten synthetic resin in an amount not enough to fill said mold cavity and subsequently introducing a mass of gas under pressure through the same entrance into said mold cavity either independently or in conjunction with a molten resin until said mold cavity is filled to capacity.

2. A method according to Claim 1, which further comprises injecting a molten resin into said mold cavity subsequently to said introduction of said mass of gas under pressure.

Detailed Description of the Invention:

This invention relates to a method for molding a hollow shaped article of synthetic resin.

Production of hollow shaped articles of synthetic resins has been heretofore effected mainly by hollow molding with an extrusion parison or by adhesive union of two or more molds. These methods restrict molded productes in shape and

yield shaped articles at great cost. In the circumstance, the need is felt for developing a more advantageous method for molding hollow shaped articles.

After a study on methods for molding hollow articles, we have perfected the present invention. This invention specifically concerns a method for molding a hollow shaped article, which comprises injecting into a mold cavity a molten synthetic resin in an amount not enough to fill said mold cavity and subsequently introducing a mass of gas under pressure through the same entrance into the mold cavity either independently or in conjunction with a molten resin until the mold cavity is filled to capacity.

Now, the present invention will be described below with reference to the accompanying drawings. Fig. 1 and Fig. 2 illustrate only the portions of typical molding devices for working the present invention which are pertinent to this invention. With reference to Fig. 1, the resin 9 which has been plasticized by a screw 2 adapted to plasticize and inject resin is accumulated within an injection cylinder 1 and the molten resin 9 is injected into a mold cavity 13 formed with dies 11 and 12 in an amount not enough to fill the mold cavity 13 and, subsequently, a mass of gas is introduced under pressure through a gas injection inlet 4 formed in a nozzle part. The gas injection inlet 4 is fixed at the center of the nozzle part with a device part 3. The mass of gas is forced through the molten resin and introduced under pressure into the mold cavity. The mass of gas 10 stored in a gas compression

cylinder 5 disposed separately is introduced under pressure when a high-pressure ram 6 is advanced inside the cylinder. The introduction of the mass of gas under pressure can be effected by any of the following four prucedure of (1) introducing the mass of gas under pressure, (2) introducing the mass of gas under pressure and subsequently further injecting the molten resin, (3) introducing the mass of gas while injecting the molten resin, and (4) introducing the mass of gas while injecting the molten resin and subsequently further injecting the molten resin, respectively after the injection of the molten resin into the mold cavity in an amount not enough to fill the mold cavity.

Now a method of this invention for the production of a hollow shaped article by the use of a device illustrated in Fig. 2 will be described. A cock valve 25 at the leading end of a first cylinder 15 is closed to enable the resin which has been plasticized by the screw of a second cylinder 18 to accumulate and fill the space defined by a backflow check valve 19, a movable mandrel 16, and the cock valve 25. At this time, since the movable mandrel 16 is closed with a valve 17, it is moved backwardly as the space is gradually filled with the resin. Then, the mass of gas passed through a valve 22 is released through a passage 21 to fill the space defined by the movable mandrel 16 and an injection ram 20. The valve stops the advance of the resin 24 in the direction of a gas chamber 24 and permits the advance of the mass of gas in the direction of the resin only when high pressure is exerted upon

the mass of gas. After the interior of the cylinder 15 has been filled with the resin and the mass of gas as opposed to each other across the movable mandrel, the high-pressure injection ram 20 is advanced and, at the same time, the movable mandrel is advanced, with the result that the resin 24 is injected into the mold cavity. When the movable mandrel reaches the leading end of the cylinder 15, the high pressure is exerted upon the mass of gas 23 enough to open the valve 17 and permit introduction of the mass of gas under pressure into the mold cavity. As the result, there is formed a hollow shaped article composed of a surface layer of resin and an inner layer of gas.

Depending on the shape of a molded product desired to be obtained, there arises the possibility of the mass of gas rupturing the surface layer of resin and rendering the molding itself infeasible. In this case, the molding is desired to be carried out with the mold cavity held under the pressure of gas.

As meand of introducing the mass of gas into the mold cavity, this invention offers choice from among the four procedures described above. These four procedures have the following differences. In the procedures of (2) and (4), the injection of the molten resin subsequent to the introduction of the mass of gas is means to block the entrance to the mold cavity with the resin. In the procedures of (3) and (4), the introduction of the mass of gas under pressure simultaneously with the injection of the molten resin is meant to effect

forced introduction of the mass of gas as wrapped in the molten resin and facilitate the entry of the mass of gas into the core of the shaped article in due consideration of the possibility of the forced flow of the mass of gas rupturing the surface layer of resin, depending on the shape of the molded product desired to be obtained.

when the shaped article desired to be molded has a large wall thickness, there is the possibility of the thickness of the surface layer of resin increasing excessively. In this case, the mold cavity is desired to be enlarged by causing the mold indicated by the symbol 12 in Fig. 2 to be moved backward to the position indicated by the symbol 14 prior to the introduction of the mass of gas under pressure.

Optionally in this invention, after the molten resin has been introduced into the mold cavity in an amount not enough to fill the mold cavity, the mass of gas may be subsequently introducedunder pressure through the same entrance to fill the mold cavity and then the synthetic resin containing a foaming agent may be further injected into the hollow space. The shaped article, for example, can be obtained with desirable quality when the molding is carried out by the following procedure. A shaped article having a foamed layer as its core is produced by molding a hollow shaped article, injecting into the hollow part of the shaped article kept under pressure of gas a foaming agent-containing synthetic resin in an amount not enough to fill the hollow part, and then lowering the heightened pressure inside the hollow part to atmospheric pressure thereby allowing the synthetic resin to foam.

As the synthetic resin for use in the present invention, any of the conventional thermoplastic resins in popular use can be adopted. Optionally, a thermosetting resin may be adopted. The resin can incorporate therein various additives.

The term "mass of gas" as used in this invention is intended to mean a substance which is gaseous at room temperature. Concrete Examples of the mass of gas include nitrogen, carbon dioxide, air, and other substances whose boiling points do not exceed normal room temperature. An inert gas such as nitrogen or carbon dioxide proves particularly desirable for this invention. The term "mass of gas" as used herein embraces substances which are liquefied under application of high pressure.

Now, a working example of this invention will be cited below.

Example:

With a device constructed as illustrated in Fig. 1, a disc-shaped article 150 mm in diameter and 7 mm in thickness. As a thermoplastic resin, polystyrene (a product of Asahi-Dow Ltd. marketed under trademark designation of "Styron #470") was plasticized at 200°C. An 8-g portion of the plasticized polystyrene was injected into the mold cavity and then nitrogen was introduced therein under pressure of 150 kg/cm^2. The molded resin was left cooling and solidifying in the mold. Consequently there was obtained a hollow shaped article illustrated in Fig. 3. After the introduction of nitrogen under pressure, about 2 g of thermoplastic resin was injected and

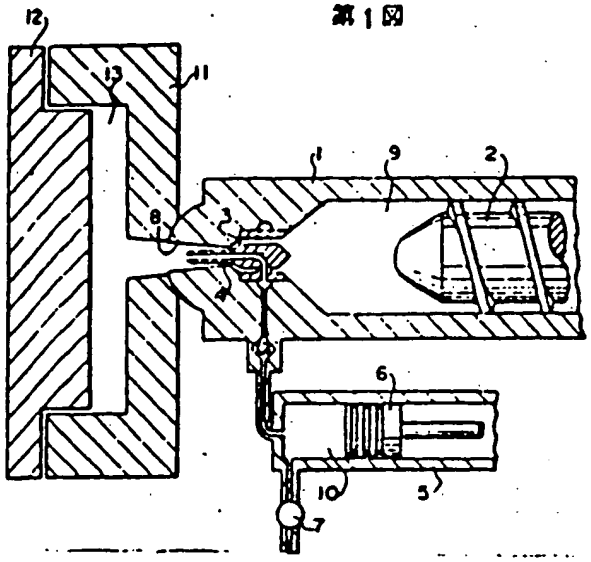
left cooling and solidifying within the mold. Consequehtly, there was obtained a hollow shaped article shown in Fig. 4. In Fig. 3 and Fig. 4, 26 stands for a resin part and 27 for a mass of gas.

This invention permits hollow articles of complicate shapes to be molded inexpensively as compared with the hollow shaped articles obtainable by the conventional method.

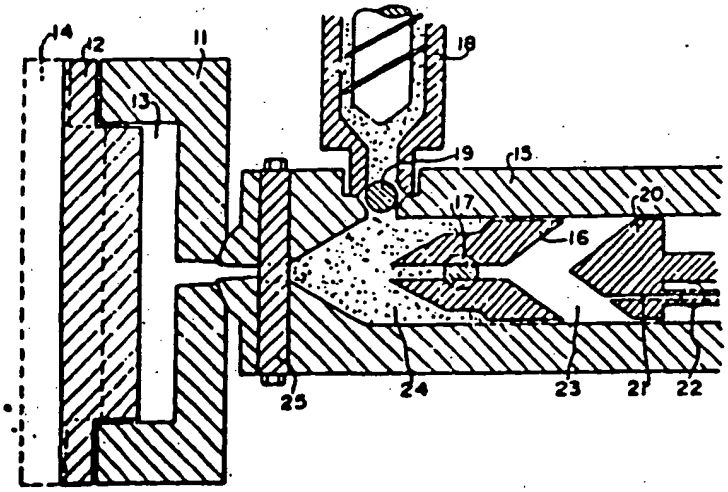
Brief Description of the Drawings:

Fig. 1 and Fig. 2 are cross sections illustrating only the pertinent portions of typical molding devices for working the present invention. Fir. 3 and Fig. 4 are cross sections of shaped articles molded by the method of this invention.

第1図



第2図



第3図

第4図